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ABSTRACT

The contextual factors that influence the infusion of technology into rural and urban schools are explored in this study of technology integration in education. Two case studies of schools that have had a technology-rich environment for at least two years are analyzed using a document review, focus-group interviews, individual interviews, and classroom observations. Organizational, technological, and human-resources profiles describe the school environments. The rural high school has 392 students in grades 8 through 12, with an overall faculty-student ratio of 1 to 10. The urban school has 1,611 students in grades 9 through 12, served by 130 faculty and staff members. In both settings, the beliefs and visions of the administration and faculty who were interviewed included both pedagogical and catalytic rationales for computer-mediated instruction. Adaptability was a characteristic of both schools, and in both there was a core of technology-using teachers who modeled appropriate technology use in the classroom. Both schools already had an extensive technology base. Characteristics of technology infusion were affected by contextual factors in each school. An attachment contains forms used in the survey. (Contains 3 references.) (SLD)

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Understanding Technology Infusion: Comparing Rural and Urban Contexts

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The intent of this presentation and paper is to highlight the contextual factors which influence technology infusion in rural and urban schools. Our goal is to describe what technology infusion looks like in these two contexts and assess how the rural or urban setting influenced the choices made by the schools. We chose the schools based on objective criteria such as the amount of technology present in the school and on the degree of success in infusing technology perceived by stakeholders in the schools. This approach allowed the teams to examine factors which led to successful technology integration in both contexts.

BACKGROUND: A CONTEXT FOR TECHNOLOGY INFUSION.

In order to fully understand the choices made by urban and rural schools in the cases investigated in this paper, it is necessary to examine the general question of technology applied to education. In their review of technology applications in education, Hawkridge (cited in Pisapia, Schlesinger, & Parks, 1993) lists four rationales for infusing technology (particularly computer technology) into schools.

1. The Social Rationale. Policy-makers want to be sure that all children are "aware and unafraid of how computers work." They should be prepared to understand computers and be aware of their role in society because computers are pervasive in industrialized countries.

2. The Vocational Rationale. There will be employment opportunities for individuals who have the proper computer skills. Therefore, it is an important competency to develop.

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3. The Pedagogic Rationale. Students can learn from computers. There are advantages over other traditional methods in using computers to learn.

4. The Catalytic Rationale. Computers are catalysts to change schools for the better. They are symbols of progress. They encourage learning.

Each of these rationales is present in varying degrees in both the rural and urban cases represented in this study. The first two rationales are more 'traditional" in that they assume that educational computing is another subject area which should be covered for both general knowledge and so that students will be better prepared to be a productive force in the workplace of the future. In fact, the business education classrooms are the most likely to include training on using computers as a part of their curriculum as a response to the pervasiveness of computers as tools for private industry. This most often takes the shape of classes in word processing, and to a lesser extent computerized accounting using spreadsheets and file management using databases. Much of this training tends to be focused on learning how to use the particular software applications (word processing, spreadsheets, and databases) for a limited set of tasks. The crossover to other curriculum areas is often not made. Nevertheless these two rationales are firmly established in secondary education settings.

The second two rationales are embraced less uniformly across different school settings and are intimately related. One of the prerequisites for the pedagogic rationale to flourish is the prerequisite or simultaneous implementation of systemic school changes. At the same time, technology by itself cannot force systemic change in schools. If students are to gain the advantages of educational computing the structure of classroom interaction between the teacher, student and technology will be fundamentally altered. Both the physical arrangement of classrooms and the redefining of teacher and student roles create the proper environment for computers to have a truly catalytic effect on learning.

All schools and/or school divisions necessarily the desire change on this scale or have the resources in all schools to implement it at this time. Hence in some ways, the result of successful technology integration is a necessary but not sufficient component of systemic change in teaching and learning (Pisapia et al., 1993, p. 13).

METHODOLOGY.

We used a modified case study approach (Yin, 1989) to examine these questions. The case study is an empirical inquiry that: investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of information are used (Yin, 1989, p. 23)

We found the case study methodology to be appropriate because it allowed us to both "describe the real life context in which an intervention has occurred,[and]...explore situations in which the intervention being evaluated has no clear single set of outcomes" (Yin, 1989, p. 23). The intervention described in the two case studies is the infusion of technology, especially computer-related technology into a rural and urban high school. A modified case study approach made sense because technology infusion can have a variety of outcomes depending on the way it is implemented, and our data source included the real life context of each school,

School selection criteria. The sites selected for analysis in this paper were extracted from a larger study of technology-intensive schools. The selection procedure was as follows. The Virginia Department of Education and technology experts nominated a group of schools for the case study team to select from. Their nominations were thought to be leading technology-using schools, each with an enabling network structure in place, and it appeared to be making a difference in how instruction was delivered in the school. Because the overall project goal was to gain a richer understanding of the impact of technology in schools, the team selected schools from this list to survey on the extent of their use of technology.

The selection criteria were: a school must have had a technology-rich environment for at least two years. Part of this environment was the availability of backbone networks at the school. This provided the proper infrastructure to evaluate if computers were being used beyond literacy and basic tool use. Secondly, urban, suburban, and rural schools were all equally considered. Finally, the use of technology to support higher-order thinking skills as part of the curriculum was another criterion for selection because it reflects that the pedagogical rationale is being applied. Of the four sites included in the project, one rural and one urban high school was selected for analysis in this paper.

After the schools were selected, a focus member study team was identified to visit each school and develop a description, documentation, and examples for the entire case study team to review. The site visits included: a review of documents, focus group interviews, individual interviews, and classroom observations.

Each visit was coordinated by one of the authors of this paper. The visit coordinator gained access to the site, and be responsible to assure that proper protocols with the school were followed. They notified team members of arrangements including travel. Each participating school was offered a list of software that they chose from as an incentive for their assistance. The software list did not contain any software over $100 and was paid through the Virginia Commonwealth University contract.

ORGANIZATION OF THE INQUIRY.

Each team observed classrooms, interviewed teachers, administrators and support personnel in the schools. The observational data was merged with the interview data to create a composite picture of how technology was being integrated within each school. The data collection instruments used in interviewing provided information on both the pedagogic and catalytic influences of computer infusion at these schools. The areas of inquiry were grouped under the general headings of: organizational profile, technology profile, and human resource profile. It was felt that these three divisions could best capture the interplay of computer-mediated instruction and systemic change in these schools. Each area of inquiry contained a set of focus questions that guided the site team as to the types of information sought, both in note taking and in drawing their conclusions.

The **Organizational Profile** described the setting, and inquired into the beliefs, visions and planning that drove the technology infusion into the school (See Case Study Protocol in Appendix A). Specific questions included:

Belief/Vision

* What is the reason you are using technology in your school?

* How do social factors (departmental relations, administration support, school culture) impact the availability of computer-related technologies in your school?

* Who has the clearest vision of use of technology in your school? school division?

* Who identified the need for the use of technology in your school?

* Who are the crucial opinion leaders in your school regarding technology? school restructuring?

Planning

* Has the school been guided by a division plan? school plan?

* How did you go about implementing your approach?

Implementation

* Based on your experience, what issues have to be faced by a school/division if they want to successfully implement technology?

The **Technology Profile** described the technology being used and inquired into the manner it is used in curriculum and instruction (See Appendix A). This set of questions addressed the hardware and software available in the school as well as investigating the kinds of pedagogical computer-related resources were used for. Participants were asked to the kinds of software they used and their reasoning for using it. They were also asked about instructional applications, degree of integration, and instructional practice. Specific questions included:

* Explain how you have integrated technology into the curriculum/instruction. What has been the most help to you in doing this?

* How many years did it take to fully integrate the technology?

* Does technology promote cooperative learning? (student-student) collaborative learning? (teacher-student) How?

* How do you evaluate your students?

* Do you use standardized tests? performance-based evaluations? What type?

The **Human Resource Profile** described the human resources available to the school and inquired into the systems that are supporting the implementation of technology into the school (See Appendix A). This area of inquiry highlights the human infrastructure which supports systemic change within the schools. The goal of this area of inquiry was to identify the kind of support which made the infusion of technology more manageable and where the more support needed to be focused. This area also inquired about the administrative uses of computing in the school. Specific questions included:

* What was the nature of the training you received?

* Were you trained on a specific system/software?

* What type of training would be the most beneficial to you?

* What type of support is provided by your technology coordinator? Principal? Library media person?

* What support do you need to integrate the technology better than it is now?

* What changes would you recommend in the design of your classroom to accommodate the technology?

Individuals within each school were selected to be interviewed by each team. As appropriate to the site: individual and group interviews were scheduled with the following groups of people:

* Teachers who are: 1) technology users; 2) non-users of technology, and 3) outstanding teachers who do not use technology;

* Administrators, including the principal, assistant principal, and appropriate central office personnel;

* Support Staff, including a building technology coordinator, library media specialist and central office technology coordinator;

RESULTS AND DISCUSSION.

In this section of the paper, the results of the two case studies are presented and analyzed by focusing on how the rural and urban contexts present obstacles or opportunities for successful technology infusion. A short introduction of the two schools will be given. Then, each of the profiles listed above will be covered for both cases. Finally, a discussion of the contextual factors which affect each profile will be presented.

Description

The rural high school (Case One) has 392 students enrolled in grades 8 through 12 with an overall faculty-student ratio of 1/10. Approximately 8% of the school's population participates in the free or reduced lunch program. This is the only high school in the division and has one feeder elementary school. This school is near the central administration office and the elementary school which enables close collaboration between the schools and central administrative staff.

The urban high school (Case Two) has 1611 students enrolled in grades 9 through 12. They are served by a 130 faculty and staff members. Approximately 10.2% of the school's population participates in the free or reduced lunch program. The urban high school (Case Two) has 1611 students enrolled in grades 9 through 12. They are served by a 130 faculty and staff members. Approximately 10.2% of the school's population participates in the free or reduced lunch program. This is one of four high schools in the division and was chosen to be the first school to receive the technologies.

Profiles: Belief/Vision, Technology, and Resources

The administration's perspective at the rural high school (Case One) keeps technology as transparent as possible to the students and promotes the "technology-as-tool" philosophy. The instructional needs drive the application of technology in the classrooms.

The vision for educational technology, especially computer-mediated instruction, stems from the strong support and initiatives from the superintendent of schools. He has placed the use of technology at a high priority level throughout the two schools in the division.

While the superintendent described his role as a facilitator responding to the needs expressed by faculty and administration, the principal and several faculty members stressed the Superintendent's role as a driving force in fostering and nurturing the technological flavor of the school. The media center coordinator and a few key faculty members maintain the momentum of technology use in the school. These leaders are largely responsible for suggesting staff development opportunities and modeling appropriate technology use which encourages other teachers to experiment with new technology-based instructional methods. Their role as stakeholders in technology was quite evident in the school.

Both the administration and the faculty held the belief that technology must be a required part of the students' experience if they are to be equipped for employment in the 21st Century. The vision for the future of technology in this division is most evident in the superintendent's desire to have the lowest computer to student ratio in the state. His view is that both staff and student access to computing equipment (hardware and software) has to remain a major focus of his efforts in educational transformation in his division. Because of this strong belief in technology integration, there is a long term commitment to expanding technology opportunities in the total school program evident in the comments from the administration, media center personnel, and faculty interviewed during the site visit.

In the urban high school (Case Two), the school division subscribes to the premise that technology tends to reduce the "lecture" style of education and promotes student thinking. The concept of the "smart school" is using the computer as a tool, not as a teaching device to help deliver certain knowledge and skills. This urban high school embraced the concept of World Class Education. They are working towards providing technology as a tool for learning and working. The goal is to provide learners with the skills to compete and excel. The school is responding to the need of elevating scores based on national standards. Technology is not viewed as a supplement but as an integral piece of the educational process.

This school was chosen as the first school to receive the Smart School technologies due to the interest of a teacher who conducted a study on computers and remedial students, a principal who was interested in investigating the use of computers and increasing math skills in remedial ninth graders, a teacher interested in offering a desktop publishing class, and a library media specialist who had already gained expertise in the new technologies. The interest of these individuals and the central office merged when the division hired a division Director of Technology. The school was selected as the pilot in the central administration's five-year technology plan.

The library media specialist and English teacher were identified as core teachers who became the change agents in the process. The media specialist assumed the role of the Network Administrator, while the teacher was allowed released time to become the Technology Facilitator. They were sent to conferences and workshops and are responsible for training and guiding the rest of the staff. The Administration is actively working with the faculty to acquaint them with the new technology and developing guidelines.

While there is a considerable installed base of technology in the rural school, there was little formal planning described by the administration, the media center personnel, and the faculty interviewed. Much of the planning appears to be "just in time" for the implementation phase of the new technologies involved.

This seemingly haphazard planning is viable because of the scale of the school division. There are no administrative or bureaucratic barriers between the superintendent, the principal, and the school faculty. Hence, coordination of projects requires less lead time and becomes easier to implement. The small scale of the school allows individual teachers to work on different platforms with no school-wide standard for computer-based instructional workstations. While long range planning has been undertaken to procure grants, it was carried out more informally through direct conversations. They need not convene formal meetings by trying to coordinate several conflicting schedules within the school.

A balancing factor to the somewhat loose planning structure is the division-wide commitment to the "Total Quality Management" philosophy. Most of the administration, support staff, and faculty have attended one or more intensive workshops in TQM. Both the superintendent and the principal had become TQM trainers and had held workshops for the faculty and staff. This exposure has led them to an overall commitment to incorporating TQM as an approach in facilitating change in the school.

The superintendent and key (technologically literate) faculty carry the majority of the planning burden in the school. In divisions this small, information can be dispersed informally through teacher modeling and one-on-one conversations, rather than through formal strategic plans and objectives. This places more responsibility on the key players in the division, but as of now, the process seems to be functioning well.

This relatively unstructured approach to planning also leaves flexibility to adjust to infusions of equipment through hardware and software grants. Recently, a number of computers and accompanying software was given to the school from IBM as that corporation purchased newer, more powerful, equipment. This windfall of hardware could be more easily integrated into the division's schools because of the "just in time" planning philosophy already in place. As the technology becomes more complex (for example, school-wide information access and data management networks), the need for comprehensive planning may become more acute.

The urban high school's technological plan appears to be the direct outgrowth of a unique collaborative vision. It seems that the school began developing a vision to utilize technology during the mid-1980s. This resulted when approximately five to ten teachers were trying to capitalize on one computer lab. Within two years a director of technology was hired by the school division to generate a division-wide technology plan. As the central office proceeded to develop its own vision, an RFP was sent to each division school to provide funding to selected sights for model schools using technology. The inception of the "Smart School" concept was derived from this linking of visions.

It was noted by several individuals that it seemed almost serendipitous that teacher interest in developing technology surfaced at the same time as the central office initiative began surfacing. This also seemed to correspond with the principal's interest in the use of technology in math classes which also was the topic of his doctoral thesis. A noted advantage of this hand-in-hand vision and planning was that the school received much more than originally anticipated.

The administration encourages the use of integrated packages and desktop publishing programs to develop creativity, enthusiasm, and communication skills in the students. Students are also able to see finished copies of their product in print which gives them a feeling of accomplishment. Therefore, integrated learning systems and other packaged instructional modules are not part of this high school's collection.

The implementation of technology from an organizational perspective has been a rather disjointed but amazingly successful process at the rural high school. The lack of documentation on the planning process reflects the informal nature of the administrative structures regarding technology infusion. For example, curriculum integration seems to be a result of individual teachers' desire to make the computer a part of the students' experience rather than a result of any written plan. Hence, there is an uneven implementation of technology throughout the different classrooms in the school due to teacher usage.

Teachers who want to use more technology are nurtured by the school and by division administration. Teachers who are more reluctant to apply technology in their teaching are not penalized. Rather, the informal modeling by successful technology-users in the school has the effect of attracting other teachers to technology slowly and gradually. When teachers show interest, they are encouraged by the administration and the technology leaders in the school. Hence, there are no formal or identifiable planning stages present in the technology implementation. The high school administration, guidance department, media personnel and faculty celebrated the superintendent's guidance, support, and involvement in the technology model implemented at the high school.

The technology plan in the urban high school was developed at the division level. The library media specialists and an English teacher are the catalysts that initiated the

proposal and continue to be enthusiastic about technology and keeping it alive in the school. In the beginning stages of implementing the plan, fifteen faculty members participated in a "change" conference. Most of the using teachers had received training during their planning periods and/or during short after school training sessions for which the teachers received recertification points. All teachers are trained on Macintosh as this is the chosen platform. Teachers received computer training but repeatedly expressed the need for continued training.

There is a computer committee that solves problems that occur dealing with access and software selection. The computer committee is comprised of administrators and a sampling of teachers across the disciplines. It was evident that the school implementation plan was concurrent with the division's strategy for a world class education standard.

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There is a computer committee that solves problems that occur dealing with access and software selection. The computer committee is comprised of administrators and a sampling of teachers across the disciplines. In the beginning this committee met weekly now the meetings are scheduled on an as need basis. The technology leaders were also encouraged to build coalitions among interested faculty and administration, and the approach has been most successful. While some continue to resist, most faculty and administrators are eager for the next level. A survey was conducted to ascertain the training needs of the faculty. As a result training sessions were developed and are offered throughout the year. It was evident that the school implementation plan was concurrent with the division's strategy for a world-class education standard by the amount of support received from that level.

COMPARING CONTEXTUAL FACTORS.

In both settings, the beliefs and vision of the administration and faculty interviewed included both the pedagogical and catalytic rationales for computer-mediated instruction. The vision of the two schools held that technology is an integral part of the educational process --not a supplement -- in each school's curriculum. In this way, technology would be an agent to transform the teaching learning process. Both schools emphasize the technology as tool rationale as well as the desire for educational computing to become

a greater part of the curriculum. In terms of belief and vision, there was little difference between the small rural school and the larger urban school.

The vision for technology infusion was shared by certain members of the administration and faculty in both schools. Both schools had a library media specialist who managed the electronic resources in the school. The urban school had another media specialist who handled more of the print-based circulation. The rural school relied on adult library aides to handle these tasks. There was also a core group of technology using teachers who modeled appropriate practice with computers.

The contextual factors are more pronounced in the involvement of the central administration. In the rural high school, the superintendent was the driving force behind technology change. The high school administration, guidance department, media personnel and faculty celebrated the superintendent's guidance, support, and involvement in the technology model implemented at the urban high school. While he described his role as a facilitator, responding to the needs expressed by faculty and administration, the principal and several faculty members stressed his role as a driving force in fostering and nurturing the technological flavor of the school. The size of the rural high school division (only one high school) allowed the superintendent to be familiar and involved with the all of the individual projects which different faculty were working on. The media center coordinator and a few key faculty members maintain the momentum of technology use in the school set by the superintendent.

The vision for technology infusion was more collaboratively held in the urban high school. This is reflected in the different levels of administration which were involved in the planning and implementation. The division technology personnel (two, who also worked with other schools), principal, and a formal committee of teachers were keys in creating and maintaining the vision for technology infusion. Division influence was more diffuse with support from a variety of technology professionals who also had other obligations and leadership was at the school level. The rural school could have the vision come more from the division superintendent because he was able to focus all of his efforts on one school. In the urban school it was the principal and teachers who created the vision and then linked the initiatives from the school with wider division priorities to begin the implementation process.

The technology and resource profiles indicate how the beliefs/visions of the two schools were implemented. A number of different technologies were observed at the rural high school. A small distance learning classroom area is operative with the school receiving Latin courses from the Wise County (VA) electronic classroom (VSEN).

The media center is well equipped for the size of the school. It has the following items available:

* computer-automated (Novell networked) card catalog and circulation systems (two student access stations are available as well as one "main desk" access computer-equipped with CD-ROM drive and Alliance Plus circulation support software)

* the Novell networked file server also has several work stations that are used in school offices to support administrative applications

* three stand-alone computer-driven CD-ROM database access stations (one is equipped with a Pioneer CD-ROM six-disc changer)

* seven Macintosh computer work stations for students (all workstations are networked to a file server which also serves as an AppleTalk LAN to most of the classrooms)

* the seven Macintoshes in the media center also have access to a network modem (i.e. Va. PEN access), to individual dot matrix printers, and have network access to a laser printer

* two single-disc CD-ROM drives are accessible through AppleTalk from all classrooms which have network access Macintosh computers (in 90% of the classrooms)

* two of the Macintosh computers are available for overnight or weekend student checkouts

* a UHF antenna for instructional television reception.

In addition to the media center, the school has a sixteen station (AppleTalk networked) Macintosh lab and a business applications lab with five (AppleTalk networked) Macintoshes and seven (stand alone) MS-DOS computers. In addition, seventeen color TV-VCR combinations are available for checkouts as well as two laser disc players and two LCD projector panels.

As mentioned above, almost all of the classrooms contain one networked Macintosh Plus computer without a hard drive. The science classroom also includes two additional Macintosh computers and three Apple II GS computers equipped with probes to measure light, pH sound, etc. The drafting/industrial education classroom offers three MS-DOS computers, including one which is interfaced with a numerically controlled wood and metal cutting tool. All of these computers include some kind of CAD software, as well as word processing.

The urban school contains 191 microcomputers, 38% of which are located in classrooms and the remaining 62% located in 8 computer laboratories (15-17 to a lab). Four file

servers support 2 local area networks with 6 CD-ROM drives and connective media (satellite, broadcast and cable TV, modem and microwave) that can move voice, video and data in and outside the building. Nineteen color TVs, 14 VCRs 3 laser disc players support these connections. A standard coaxial cable connects all rooms in the building. Dot matrix and 3 laser printers are available on the network and are placed at various places in the building. The school uses the Alexandria Library Management software, Dialog, and Va. PEN (Virginia Public Education Network, a bulletin board and Internet access site) as networked resources. Stand alone tools include Grolier's Electronic Encyclopedia, NewsBank, Level III video discs and RGB and LCD projectors. The school is supported by a MECC subscription. The electronic classroom is equipped with a steerable satellite dish, speaker phone, fax machine, and networked computer work station.

The two schools have taken different approaches in their choices for acquiring technology for the schools. The goal of the superintendent was to have the lowest computer/student ratio in the state. This ratio, currently 1:6. will drop to 1:5 when a set of Intel 286 based machines donated from a local industry are installed. Each teacher has access to a Macintosh Plus that is on a local-talk network to the media center file server. Hence, connections can be made to the media center for textual data or to access Va. PEN by any teacher in the school. The urban school chose to invest in a more extensive networking infrastructure, including the ability to transmit voice, data, and video, as well as providing a Macintosh LC computer and printer in each classroom (although these are not networked yet). This more advanced network structure allows for the centralization of cd-rom and videodisc players in the media centers. It also allows for the satellite programming to be brought directly into the classroom.

Instructional applications in both contexts are primarily implemented by the lead technology teachers. Both settings have exemplary projects in technology integration. Both schools have lead teachers in English/Journalism who integrate desktop publishing and word processing into their courses and business courses which stress computerized office skills. In the rural school, lead teachers in science and industrial arts have integrated the use of computing tools into the curriculum. The urban school has integrated calculators into some of the mathematics courses.

Both schools have an imbalance in the level of technology implementation across the curriculum. It is still the lead teachers who are the technology users in their respective schools. A second tier of teachers use word processing for preparing materials and gradebook programs are technologically literate, but have not integrated technology into their instructional delivery. Finally there is a core of unbelievers who try to have minimal contact with technology.

It seems that both schools are struggling to get beyond modeling technology use by experts to more broad-based technology integration into classroom activities by the

second tier teachers. Achieving this goal takes on different forms in the two contexts. In the rural school, there is little formal structure for the diffusion of technology-based instruction around the school. The lead teachers model appropriate technology use and provide informal assistance to teachers who would like to follow their lead. The media center coordinator is also a key trainer in technology related instruction, but does this on top of her other duties. In effect, there is little formal staff development on technology use in the school. However, given the small size of the school, the teachers are more aware of the different and innovative uses of technology by their peers. Several teachers described informal networking and sharing of ideas, often facilitated by the media center coordinator, as the way they received information and training on technology-based education.

The urban school has a more formalized structure for diffusing technology to the computer-literate but noncomputer-using faculty. The English teacher, who is a lead teacher in technology, has had her time re-allocated so that she has two paid periods a day to help other teachers integrate technology into their curricula. One of the two media coordinators has time allocated to be a network administrator for the two LANs operating in the school and also helps on technology training. The council leaders of the school devote time on each agenda to the technology and a computer committee meets periodically to discuss the current and future status of instructional computing in the school. The division has a technology coordinator who allocates part of his time to technology training.

The differences in the approaches to implementation and diffusion of technology-based teaching and instruction have some of the same shortcomings according to some of the second tier technology using teachers. In both contexts, the non-lead teachers cited the need for more support to help them participate in the technology infusion effort. In the rural school, despite the availability of role models and relatively complete technology base, many of the teachers interviewed cited the need for additional school-based training in computer-use. In the urban school, all teachers interviewed felt the strong administrative commitment and support but cited the need for more training. The central office technology person first felt that after initial start-up training demands would decrease. Such has not been the case. As more training is conducted, even more is requested. All teachers recommended release time or paid stipends over the summer and do not prefer weekends or after school times for scheduling inservice and continuing education programs.

SUMMARY AND CONCLUSIONS.

Despite the apparent differences in the two school divisions, certain similarities in the two contexts were observed.

* Adaptability was a characteristic found in both schools. The rural school showed this through the ability to integrate various platforms into different areas of the curriculum. The urban school showed flexibility in the way that the lead technology teacher was given time off to help other teachers with training and implementation.

* In both contexts, the belief/vision statements were very much alike. "True believers" in both schools wanted technology as an integral part of the educational process--not just an add on.

* The media center coordinators played key roles in managing the technological infrastructure, especially coordinating the local area networks, training teachers and students on cd-rom technology, and suggesting new ways to use information technology in subject areas.

* In both contexts, there was a core of technology using teachers who modeled appropriate technology use in their classrooms. These teachers were "keepers of the vision" who maintained the momentum through implementation of their technology oriented lessons.

* Both schools were facing the problem of moving beyond the "true believers" to encourage other teachers to become more technologically literate and use technology in their teaching. The need for more training and the time to design new curriculum units using technology was a problem cited in both contexts.

* Teachers at both schools felt strong administration support for technology infusion, but cited the need for more computing resources to facilitate classroom applications.

Many of the contextual differences become more pronounced in the ways that some of the commonalties were manifested in practice.

* Although both schools had administrative support, in the rural context, an off site administrator was the visionary who inspired and motivated teachers to explore and implement technology. Teachers who were "keepers of the vision" were working closely with the superintendent on obtaining hardware, software, and other support, but he created the environment for technology integration. The urban school had more leadership from the building level through the principal and lead technology teachers. It is unlikely that division level administrators would be

able to implement systemic changes at the school without strong support from the building personnel. While both leadership models worked in their respective contexts, they are not interchangeable.

* Both schools had an extensive technology base. In the urban context, there was a division technology plan which included extensive integration and standardization of the computing and technology resources in the school. The rural school had an assortment of platforms without much consistency between the classrooms. This was a workabie plan for this school, but may have caused more scheduling difficulties and compatibility problems in a larger school where teachers have to work in several different rooms.

* The two schools also dealt with the common problem of teacher training in different. In the rural context, training was conducted informally through one-to-one sessions conducted by lead teachers or the media specialist. This was feasible because of the small faculty at this school. The urban school had the resources to allocate part of a teacher's time to training each day as well as a more extensive inservice programs.

* Diffusion of the technology was also accomplished in different ways. The rural school relied on word of mouth between the teachers to share ideas about using technology, while the urban school had a computer committee which met weekly to discuss computer-related issues and smooth out problems.

In conclusion, the rural and urban schools examined in this paper shared many of the same problems in infusing technology into their academic programs. Several of characteristics of successful technology infusion were present in both settings. However, these characteristics were colored by the contextual factors specific to each school. It is important to include the strengths found in the technology infusion examples cited in this paper and to allow for flexibility in adapting these strengths to fit the contextual factors which arise in a particular setting.

References

Pisapia, J., Schlesinger, J., & Parks, A. (1993). Learning technologies in the classroom: A review of the literature. Richmond, VA: The Metropolitan Educational Research Consortium.

Pisapia, J. (1993). Lessons learned from technology intensive schools. Richmond, VA: The Metropolitan Educational Research Consortium.

Yin, R. K. (1989). Case study research. Newberry Park, CA: Sage.

APPENDIX A

CASE STUDY PROTOCOL

CASE BOUNDARIES

The purpose of the case studies is to identify examples of technology usage that promote the implementation of the core curriculum and world class standards.

SELECTION

The Department of Education nominated a group of schools for the case study team to select from. Their nominations were thought to be leading technology-using schools, each with an enabling network structure in place, and it appeared to be making a difference in how instruction was delivered in the school.

After discussion, the case study team selected four schools to visit: one elementary, one middle school and two high schools. Together they are rural, suburban and urban in nature. Each school has the technology in place: 1) Enabling infrastructure i.e. local area networks; 2) Distance Learning; 3) Library Media Center. A list of schools is found on the next page.

PROCESS

A study team composed of three project 91-90 members and one university consultant were identified to visit each school and develop a description and examples for the entire case study team to review. The teams are identified on the next page.

The site visits include: a review of documents, focus group interviews, individual interviews, and classroom observations. Each visit will be coordinated by the individual from the project team identified on the next page. The visit coordinator will gain access to the site, and be responsible to assure that proper protocols with the school are followed. They will notify team members of arrangements including travel. Each participating school will be offered a list of software that they may chose from as an incentive for their assistance. The software list will not contain any software over $100 and will be paid through the VCU contract. The team members will be reimbursed from the Department of Education. The university members will be reimbursed from the VCU contract.

Each member of the team will take appropriate notes related to the protocol. The site visit team will debrief following the visit. Each member will submit a brief summary of the vignettes, special testimonials, and examples that illustrate the findings that the site team presents on form 6 (Attached).

The university-based consultant is responsible for preparing a 3-5 page paper presenting the findings from the visit. The paper will 1) describe the setting within which the school operates (form _); organize the teams conclusions according to the areas for inquiry identified in the protocol; and 3) in its concluding paragraphs, seek linkages between program arrangements, activities and outcomes supported by select vignettes, special testimonials, and illustrations. The paper should be submitted within 5 days of the visit.

DOCUMENTS

A copy of plans or other appropriate documents that the school has prepared should be gathered and attached to the final report. No attempt should be made to request that information be especially prepared for the site visit except filling out the Equipment Description (attached).

INTERVIEWS

As appropriate to the site: individual and group interviews will be scheduled with the following groups of people:

Teachers who are: 1) technology users; 2) nonusers of technology, and 3) outstanding teachers who do not use technology;

Administrators; including the principal, assistant principal, and appropriate central office personnel;

Support Staff; including a building technology coordinator, library media specialist and central office technology coordinator;

Students and parents.

OBSERVATIONS

In addition to the review of documents and interviews, the site team should attempt to see as many uses of the technology as possible during their stay.

AREAS OF INQUIRY

The areas of inquiry will be grouped under the general headings of: Organizational Profile,
Technology Profile, and Human Resource Profile. Each area of inquiry contains a set of focus questions (attached) that should guide the site team as to the types of information sought, both in note taking and in drawing their conclusions.

The **Organizational Profile** will describe the setting, and inquire into the beliefs, visions and
planning that are driving the technology infusion into the school (Form 3).

The **Technology Profile** will describe the technology being used and inquire into the manner it is used in curriculum and instruction (Form 4).

The **Human Resource Profile** will describe the human resources available to the school and inquire into the systems that are supporting the implementation of technology into the school (Form 5).

DEBRIEFING

Following the site visit and preferably before dispersing, the team will debrief on what they saw, give direction to the case reporter (university member) for the written report. (Perhaps having dinner together before heading home will facilitate this meeting.)

WRITTEN REPORT

The university member will collect the notes (Form 6) or team members may wish to fax them to the case reporter. The case reporter will develop a draft of the visit within 5 days and fax a copy for review to the team. The case reporter will fax or bring the case to the concluding meeting of the case study team.

SITE VISITS

Elementary Schools

Highland Park - Roanoke (model school)
- Urban
- Federal Funding
- Planning
- Multi-Media

Team:
Gordon Creasey, Randy Agee, Wes Batten (Coordinator) and Sheary Johnson

Middle Schools

Short Pump Middle - Henrico - February 3, 1993
- Design
- Restructuring
- County Funds

Team:
Jean Weller, Mano Talaiver, Richard Kravitz (Coordinator) and John Pisapia

High Schools

Bethel High - Hampton
- Curriculum Integration
- Redesign Conversion
- Urban

Team:
Richard Kravitz (Coordinator) Mark Delp, Mano Talaiver and Sheary Johnson

Rappahannock High - Front Royal
- Rural
- Conversion
- Partnership with Potomac Edison has given a different Flavor to technology

Team:
Gordon Creasey (Coordinator) Wes Batten, Randy Agee and Sherwood Wang

Form 1

ORGANIZATIONAL PROFILE
Demographics

Protocol: Please provide the following information:

School Name: _____

Street: _____

City/Zip: _____

Phone: (___)_____

Feeder Schools_____%Free/Reduced Lunch_____

Community Services Used_____# Faculty_____

Faculty Average Age_____ Grades_____ Enrollment_____

Enrollment at each grade:

K___ 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10___ 11___ 12___

_____ Principal

_____ Assistant Principal

_____ Library Media Specialist

_____ Technology Resource Person

Leading Technology Using Teachers	Technology Using Teachers	World Class Teachers Who Do Not Use Technology
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

ORGANIZATIONAL PROFILE

Form 2

Protocol: Please identify the equipment available in your school building and the major teacher utilization.

EQUIPMENT DESCRIPTION

	Y/N	#	Vendor	Major Use	Comments/Observations
Micro Computers					
Local Area Network (LAN)					
File Servers					
Computer Labs					
Laser Printers					
Color Television Sets					
VCRs					
Laserdisc Players					
CD-ROM Players					
CD-ROM Servers					
LCD Projector Panels					
SYSTEMS					
ILSs					
Writing to Read					
Lab 2000					
Other Systems?					
Distance Learning					
Master Antenna TV					
MECC Subscription					

ORGANIZATIONAL PROFILE

Form 3

Protocol: The following areas should be explored: Notes, Illustrations, Comments

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Focus Area : Belief/Vision
What is the reason you are using technology in your school? What do you want technology to accomplish with it? How do social factors (departmental relations,administration support, school culture), impact the availability of computer related technologies in your school? What are your students' beliefs regarding the value of computer related technologies in their lives, now and in the future? What is your perception of the role of computer related technologies? Now? 5 years from now? 10 years from now?

Who has the clearest vision of use of Technology in your school?, school division? Who identified the need for the use of technology in your school? Who are the crucial opinion leaders in your school regarding technology? School Restructuring?

Focus Area: Planning
Has the school been guided by a division plan? School Plan? For the acquisition of technology? Who was involved in planning? Does the plan contain a minimum foundation level of technology? Is there a minimum configuration division will support? Can it vary? What was your approach to planning? How did you go about implementing your approach? Based on your experience, what issues have to be faced by a school/division if they want to successfully implement technology? Are you familiar with the VDOE's 6-year Technology Plan? Did you use it in planning? How?

Focus Area: Implementation:
Can they identify stages that they went through? What stage are they at?
What can you expect at different stages?
Did they have to change curriculum? What was biggest barrier to implementation? Facilitator?
Have you integrated technology into the curriculum? If no, why not?

Form 4

TECHNOLOGY PROFILE

Protocol: The following areas should be explored: **Notes, Illustrations, Comments**

Focus Area: Technology Applications:

For those applications available in the school (listed below), - Ask- Why do you use "**Distance learning**"? How do you use it? What do you think its best uses are?

Why do you use multimedia? etc.

Telecommunications,

ILSs,

Desk Top Publishing,

MLBs,

Focus Area: Instructional Applications:

For the applications listed below, **ASK**: Do you use Drill and Practice software? How often? Why? How do you use it? What specific software would you recommend to other teachers? (Note: ask yourself, how does it support Common Core?)

Tutorials,

Simulation,

Problem solving,

Word Processing,

Spreadsheets,

Data Base,

Graphics,

Telecommunications.

TECHNOLOGY PROFILE

Form 4

Protocol: The following areas should be explored: **Notes, Illustrations, Comments**

Focus Area: Integration
Explain how your have integrated technology into the curriculum/ instruction. What has been the most help to you in doing this? How many years did it take to fully integrate the technology?

Focus Area: Instructional Practice:
Does technology promote Cooperative learning? (student-student)
Collaborative Learning? (teacher-student)
How? Does technology promote Individualized Instruction?
How? What products have your students produced with technology applications?
How do you evaluate your students?
Do you use standardized tests?
Performance-Based evaluations?
What type? How much actual keyboarding time do your students receive?
Is there a standard? How do you insure equity? Has the way you teach changed because of the technology you are using? Explain!
Do you use your time differently? How?

RESOURCE PROFILE

Form 5

Protocol: The following areas should be explored: **Notes, Illustrations, Comments**

Focus Area: Training:
Explain how long it took to get comfortable using the technology? (1-2 yrs.)
What was the nature of the training you received? Were you trained on a specific system/software?
Did you receive training that showed you the possibilities of using the technology? What type of training would be the most beneficial to you?

Focus Area: Software:
Do you review software before using it?
Does your division have a review process?
How do you know what to order? What type of software would be the most beneficial to you? Has the software modified how you use textbooks?

Focus Area: Administrative Support:
What type of support is provided by your technology coordinator? Principal? Library media person? What kind of staffing and support is in place?
You made the investment -- do you have the support? What support do you need to integrate the technology better than it is now? Were you granted released time, extended contract or paid extra to learn how to integrate technology into your classrooms?

Focus Area: Facilities:
What changes would you recommend in the design of your classroom to accommodate the technology?

Focus Area: Teachers' Administrative Uses
How do you use technology for administration of your classes?

CASE STUDY SUMMARY SHEET

Form 6

Protocol: Please summarize examples, testimonials or illustrations that you observed or were told on the site visit: Turn this sheet in to the case study reporter.

BELIEF PROFILE

ORGANIZATIONAL PROFILE

TECHNOLOGY PROFILE

HUMAN RESOURCES PROFILE

TEACHERS ADMINISTRATIVE USES OF TECHNOLOGY

TEACHERS INSTRUCTIONAL USES OF TECHNOLOGY

INSTRUCTIONAL SUPPORT SYSTEM

Administrative Support

Instructional Support

Community Support